Railways of Australia

NETWORK

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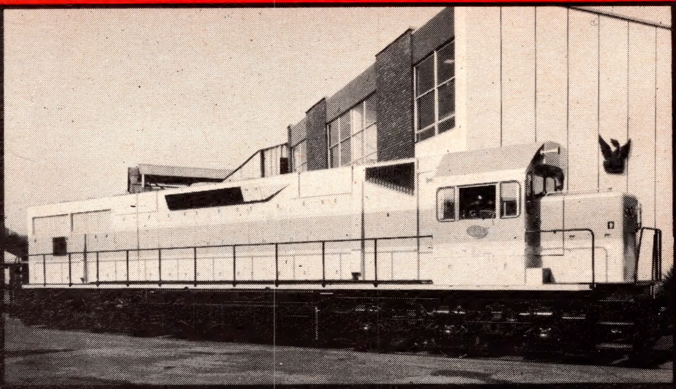
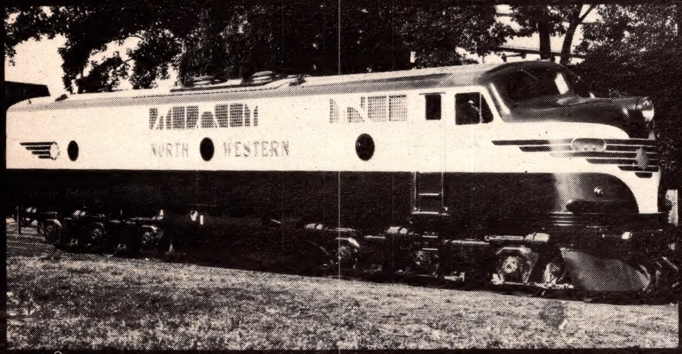
Q.R. Model GL26C 2200/2000 HP


W.A.R. L Class 3300/3000 HP

HONG KONG GOVERNMENT RAILWAYS Model G16C 1950/1800 HP

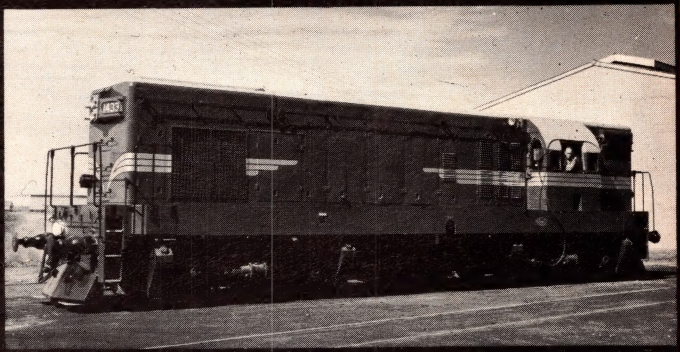
VICTORIAN RAILWAYS Y Class 650/600 HP

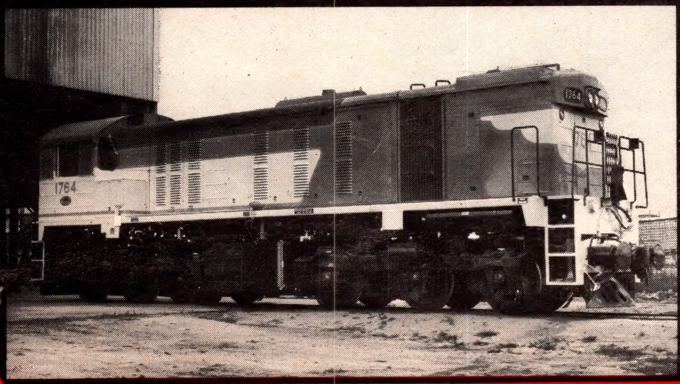


PAKISTAN WESTERN RAILWAY Model ML3 1650/1500 HP

P.T.C. OF N.S.W. 422 Class 2200/2000 HP

B.H.P./WHYALLA Model G12B 1425/1310 HP


NEW ZEALAND RAILWAYS Model G12A 1425/1310 HP



Q.R. Model GL18C 1100/1000 HP


CANEFIELDS AND INDUSTRIAL Model DHI-71 220/170 HP

Upgrading of Westrail's standard gauge railway line between Kwinana and Koolyanobbing calls for replacement with 60 kg/m rail.

Late last month old 94lb rail was removed at the western end of Meckering station yard and replaced with a new 23 tonne railway line set (turnout).

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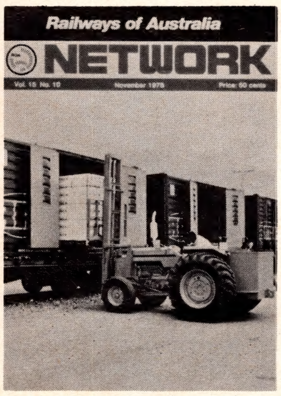

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- Victorian Railways
- Western Australian Government Railways

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CONTENTS

OUR COVER

Loading fruit at Bowen, Queensland, bound for Sydney.

The South Brisbane-Roma Street rail link, incorporating the Merivale Bridge, officially opened on 18 November, 1978

Railways of Australia
NETWORK

From the Executive Director's Desk

Re-examining the Railway Role

There are heartening signs that the contribution of rail transport to the economic and social well-being of the modern world is being re-examined and re-assessed.

For fast, reliable and economical movement of bulk commodities the railway is unrivalled. Eight to nine trains a day, each 1½ km long, carry millions of tonnes of ore annually from Mt Newman to Port Hedland over 426 km of welded track. Other trains travel similar distances to Dampier. The privately owned railways in the north-west of Australia have, by their choice of transport, confirmed that the most economic and efficient method of bulk movement over long distances is by rail. Government railways in all states of Australia currently operate bulk movements of ore and coal; they also carry millions of tonnes of grain harvests from country silos to the export terminals.

In Canada, freight trains of 10,000 tonnes run regularly over a 2000 km route carrying coal for Ontario's electricity generators. For mineral and grains traffic, there are no alternatives; rail is essential.

Fast and direct transport of fruit and vegetables over even greater distances to urban markets — such as the run from Bowen in North Queensland to Sydney and Melbourne — has been made possible by the development of containers.

Vans and containers have also revolutionised mixed goods traffic; overnight services carry them to recognised "freight centres" from which the last leg of the journey is made by a connecting road-carrier service. Here, rail and road are complementary; each performs the role for which it is best suited; and rail is winning back some of the traffic lost to road in pre-container days.

The consequences of over-generous limits for heavy traffic on the roads have been made startlingly clear in the United States, where loads up to 36 tonnes have been permitted. Damage to highways has precipitated demonstrations and strikes; and expenditures up to $25,000 million a year, for ten to twelve years, are now postulated for the restoration and rebuilding of major highways.

This expenditure, and the maintenance charges that follow, represents a stupendous subsidy by taxpayers and is a matter of paramount importance when considering load limits on Australian roads. The only way these costs can be controlled, and the roads kept safe for normal community traffic, is by encouraging and equiping rail to handle all heavy and long-distance freight.

Canada has taken another major step. Via Rail Canada, government-sponsored, is taking over passenger services previously operated by Canadian Pacific and Canadian National Railways. With this separation of passenger and freight operations, the social and economic services provided by the Canadian railways will be identified more clearly. Via Rail will seek to rationalise the passenger transport programme, to minimise the subsidy required to maintain it, and to ensure clear appreciation and discussion of the alternatives to continued community support — higher fares or curtailed services.

In Britain, where distances are small by Australian or American standards and the proportion of passenger to freight traffic is much higher, the concept is being studied of a "social fare" to be allocated for each passenger service. This concept has been extended by the negotiation of a "contract" between railway and Government by which an agreed fee or allocation is calculated to cover particular operations. British Rail has already saved substantial amounts on its "contracts" both in 1976 and 1977.

This concept has enabled British Rail to be judged by its efficiency, its record for safety and reliability, and its contribution to community welfare. There can be no question of *losing money* if it performs its functions within the terms of a contractual agreement.

The realisation that British Rail is operating successfully and has an assured role in the transport field has transformed staff morale and stimulated a new and positive attitude in its public relations.

Railways everywhere have many advantages to emphasise, at both the political and the general public level. The road toll in deaths and injury is horrendous; the railway record is infinitesimal. The noise, pollution and highway congestion caused by industrial lorries menace the well-being of millions in industrial suburbs; each new highway provides only temporary relief from traffic congestion. Railways handle their millions of tonnes independently of community traffic.

In short, rail travel is good value for money — whether it be money invested in installations and equipment, or that spent by the user for transport.

The Leitch Committee, enquiring into trunk roads in Great Britain, emphasised the futility of expenditure on new highways alongside existing railways, and insisted that costs and benefits of all new projects be rigorously assessed. In future, British Rail will be duly considered when new trunk road proposals are evaluated. This procedure is currently practiced in the Federal Republic of Germany and the USA.

In any review of the allocation of funds for transport needs, it is essential that railway considerations be duly considered, rather than ignored, as in the past.

With the impending fuel shortage, a re-examination of the railway role must be undertaken. Let's start now.

B. M. HOGAN
Executive Director

1967 was a great year for wrought steel wheels

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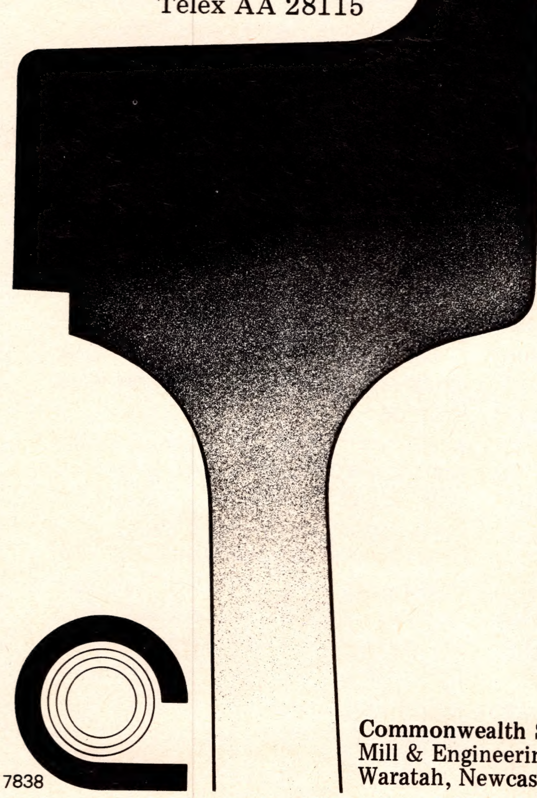

CRP7 7838

Commonwealth Steel Company Limited,
Mill & Engineering Products Division,
Waratah, Newcastle. NSW. 2298.

From the left: A. B. Holm, Chief Civil Engineer Westrail; R. J. Pascoe, Commissioner of Railways - Westrail; J. F. Pearce, International Engineering Co. of San Francisco, USA; W. J. Adamson, Signal & Communication Engineer, Westrail; and A. F. Irving, Senior Accountant, Project Studies, Hamersley Iron.

The Heavy Haul Railways Conference

September 1978

Experts from all over Australia and fifteen other countries flew into Perth, Western Australia, to take part in the world's first Heavy Haul Railways Conference, which was held at the Sheraton Hotel over five days, September 18-22, 1978.

The Conference, organised by the Institution of Engineers, Australia, and the Australasian Institute of Mining and Metallurgy, on behalf of Cliffs Robe River Iron Associates, Goldsworthy Mining Ltd, Hamersley Iron Pty Ltd, Mount Newman Mining Co. Pty Ltd and Westrail, stemmed from the fact that Australia has a wealth of knowledge to impart to the operators of the world's railway systems.

In the past ten years enormous demands have been made on railway systems everywhere — and it may come as a surprise that research in Australia has led to much of the knowledge available today.

The vast amount of research for example, concerning the problems of the heavy-haul railway systems in the Pilbara Region of Western Australia has never before been revealed.

This is one reason why the conference attracted so much international interest. More than 150 people came to Perth from overseas to share in the exchange of information, and though the conference may not have been quite to the taste of the amateur railway enthusiast, the ideas exchanged could lead to significant changes in the world's railway systems.

Problems & Costs v. Benefits

The conference opened with a warning from the president of the American Railway Engineering Association, Mr W. S. Autrey, who gave the invitation address, that the problems and costs associated with hauling heavy loads often outweighed the benefits.

Mr Autrey pointed out that marketing strategy seemed to dictate increased loads because the use of bigger railway wagons resulted in fewer wagons and fewer trains to carry the same loads. Theoretically, this should result in lower operating costs and the theory had become a contingent marketing strategy for most railway operators.

However, it had been found that when bigger wagons were used, the cost of maintenance and track repair was greater than the savings in operating costs.

If wagon sizes were increased, the resulting higher axle-loads resulted in accelerated destruction of the railway track. If the axle load was doubled, the wear on the railway line increased by a factor of eight. American railway companies had found that the use of heavier 125- +78% tonne wagons, instead of 70- or 25% 100-tonne wagons, had resulted in a 20 per cent increase in maintenance costs.

From the engineers' point of view it would be ideal if companies reverted to using lighter cars but there was little likelihood of this happening because it would be viewed as a backward step.

Engineers, therefore, had to live with reality. They had to work at solving the problems associated with heavy-haul railways, at ways of refining and improving the materials so that railway lines would be able to handle really big loads.

Testing High-Strength Rails

Mt Newman Mining Co's 426 km of continuously welded rail between the towns of Newman and Port Hedland in the Pilbara Region of Western Australia is one of the most heavily used sections of railway in Australia. Between eight and ten

trains each more than $1\frac{1}{2}$ km long leave the Mt Whaleback mine daily. The action of these trains, with an average axle load of more than 30 tonnes, has caused fast deterioration of the rails.

Mr P. Curcio, a Senior Experimental Officer with BHP's Melbourne Research Laboratories, told the conference that the wear rate had necessitated very costly inspection, maintenance and rerailing programmes, and research had been undertaken by the Laboratories, on behalf of Mt Newman Mining Co., to study this wear-rate problem and to find possible solutions.

A major effort had been made to develop and test new rail steels. As a result, high-strength rails have been produced by BHP and placed at selected curved and straight sections on the Mt Newman track so that their performances can be assessed under actual operating conditions.

The aim is to determine the type of rail best suited to the conditions present on the Mt Newman track on a cost/performance basis. Consequently, the trials have also included high-strength rails produced by overseas manufacturers such as Japan, USA, Russia and Germany.

"A total of twelve curves are being used with varying physical characteristics such as curvature, superelevation, gradient and train speed", Mr Curcio explained. "Each curve contains a variety of rail types which have been laid in strings of at least 70 metres on both inner and outer rails of the curves.

"Conventional rails currently being used are also included in each curve so that a direct comparison can be made of the performance of the high-strength rails to the standard type. Monitoring of rail wear in these trial curves is conducted about every six months, during which time the rails have been subjected to about 20 million gross tonnes of traffic."

He said a prolonged programme of testing was necessary before the relative performance of the different rail types could be confidently assessed. A quantitative estimate had to be made of the extra life which would result from the use of the various high-strength rails. Of equal importance was the assessment of the economic benefit obtained for the extra cost involved in purchasing these rails, either from local or overseas manufacturers.

Combating Rapid Rail Wear

A Track Maintenance Engineer, Mr B. Oliver, told the conference that information gathered from railway systems that used lower and more varied axle loadings had not prepared Mt Newman Mining Co. for the fast rate at which its rail track deteriorated.

The loads carried by the Mt Newman trains had not been experienced elsewhere and, as a result, problems emerged on the Mt Newman line which had not previously been encountered.

Rapid rail wear was usually caused by flanges on the wheels "biting" into the sides of the railhead and grinding away metal from both the rail face and the wheel flange. Though this was a common occurrence in curved sections of track it had also become evident in straight, or tangent, track in a form known as "hunting" or "snaking" because of the side to side motion of the ore cars.

By 1976 this wear pattern was evident in about 300 km of track and threatened to disrupt production. Trains would have had to run more slowly, or premature rerailing would have been necessary.

To defer the costly procedure of rerailing and to keep production on schedule, the idea of transposing worn rails was hit upon. "Hunting" caused wear on one side of each track only, and by switching lengths of rail so that the unworn section could be used the company had found a partial solution to its problems.

Research conducted on Mt Newman's track in conjunction with BHP's Melbourne Research Laboratories and Hamersley Iron indicated that the cause of the "hunting" was misalignment of welds joining the rails. The welds had been spaced at such a distance apart that they increased the amount of natural side to side motion of the ore cars.

As a result of this research and of in-track experimentation, "hunting" had now been economically controlled by a combination of transposing rails and continuous reprofiling of the shape of the railhead. The reprofiling was carried out by large mobile grinding machines as they moved along the railway line.

Production could be maintained at acceptable levels and rerailing could be deferred until rail fatigue made the operation necessary.

Optimum Axle Loads

F. D. Acord, Chief Mechanical Engineer, Union Pacific Railroads, USA, reviewed the constant increases in rail truck size, and the ultimate problems encountered.

Axle loading has increased steadily to a current maximum load of 35 tonnes, which is developed on each of the axles of the largest ore-carrying rail trucks when fully loaded. Problems are encountered when the load reaches this magnitude, and controversy exists as to whether the highest practicable axle load has been achieved.

Large axle loads adversely affect the wheels of railroad trucks by increasing the rate both of wear and deformation. Wheel wear represents the loss of metal from the original tread profile. Wheel deformation is the moulding of the original wheel profile into a different, and unsuitable, shape. Wheels constructed of high-carbon steel will resist wear but are subject to thermal cracking (caused by different parts of the wheel heating and cooling at different rates). Low-carbon steel wheels are less brittle and resist thermal cracking, but they are also softer and wear down more quickly. It appears then, that a wheel of optimum carbon grade exists, which will sustain and axle load of a definite, limited magnitude. However, other factors also affect wheel wear and deformation, and research is currently being conducted into these associated conditions.

Large axle loads also cause increased wear and deformation of the rails. The main problem is "shelling", which is a particular type of deformation. An example of this problem can be seen in the Black Mesa and Lake Powell Railroad, which opened new as a coal-carrying road using trucks with an axle load of 35 tonnes. Soon it was discovered (among other problems) that the rails were badly "shelled" on all curves. One of the corrective measures implemented was to underload the trucks so that the axle weight did not exceed 30 tonnes.

Generally speaking, "shelling" is the major cause of rail replacement, and therefore the largest single maintenance-cost factor. By comparing maintenance cost against

axle load, it is seen that for axle loads of 20 tonnes or under, the cost is steady. Increasing maintenance costs occur when axle loads over 20 tonnes are used. Mr Acord contends that the increased maintenance costs can only be successfully absorbed for axle loads of up to 30 tonnes, and that any railroad operating with higher axle loads will certainly incur very heavy costs.

Driving Problems

Mr C. W. Parker, Assistant Chief Mechanical Officer, CP Rail, Canada, pointed out that with the exception of certain North American railroads, where freight trains in excess of 100 loaded cars have been commonplace in the last 20 to 30 years, most locomotive drivers throughout the world have learnt the art of freight-train handling with relatively short trains in most cases from 30 to 60 cars per train. Within the last two decades a number of new railways have been built to transfer bulk export commodities such as coal and iron ore. For a variety of reasons these railways have chosen to operate extremely long and heavy trains.

The length and weight of these larger trains necessitates the use of AAR-type couplings which imply approx. 15 cm of slack per car. This slackness is the basis of the problem of handling long trains, as different parts of the train can be travelling at differing speeds whilst under acceleration or braking, whether due to locomotive power or braking or the grade of the track itself.

It is most important that the drivers of these massive trains have complete knowledge of the curves and slopes of the track as well as being thoroughly familiar with the characteristics of the equipment under their control. Ill-timed application of either power or braking can easily cause large compressive or tension forces within the carriage couplings as well as large sideways forces on curves. If these forces become large enough, couplings may be broken or derailment may occur.

The safe passage of the goods and equipment depends on the driver's intuitive feeling for the interaction of throttle and brake applications, as well as his awareness of the forces induced between the carriages. For this reason, drivers require adequate initial training and a competent supervisory staff to control the handling procedures used in the operation of long, heavy trains.

Up-grading for Heavy Traffic

Mr J. H. S. Oliveira, Director of the Federal Railways of Brazil, outlined Brazilian experiments and experience with special rails for heavy-haulage lines.

In Brazil there are two main iron ore "transport corridors", the Estrada de Ferro Vitoria a Minas (EFVM), between the mine area at Itabira City and the port of Tubarao, 550 km away on the Atlantic coast, and the Linha do Centro (LC), formerly the Central Brazil Railway and now the property of the Brazil Federal Railways Network, which runs for 646 km between the mineral complex at Belo Horizonte and the ports of Sepitiba and Rio de Janeiro.

Both railways were originally designed for transportation of goods and passengers across country of considerably agressive configuration. The EFVM is a 1.0 m gauge link originally built for the transport of 1.5 net million metric tonnes per annum (NMTPA) of iron ore and has now reached a transportation level of 60 NMTPA, about half its potential capacity. The LC is a broad gauge 1.6 m railway with a present transportation demand of 30 NMTPA.

Since 1952 the EFVM line has been progressively upgraded for the annual transportation of 6, 20, 60 and finally 120 NMTPA; and, of course, many facets of the railway superstructure have had to change considerably to cater for this vastly increased load. This involved reballasting of the track (in parts it was not ballasted at all) and increasing the ballast height to 0.3 m and later to 0.4 m, energetic compacting of the roadbed, and increasing the size of the timber sleepers. The sleepers were also treated and chemical weed control introduced along the railroad. The conventional type of spike fastening was replaced with elastic fastening and concrete sleepers were utilised on an experimental basis. A decision as yet has not been finalised due largely to the fact that abundant fine wood is available locally and the concrete looks uneconomical in comparison.

Finally, total replacement of all rails was undertaken from 35 kg/m rails to 57 kg/m and then to 67 kg/m, head hardened by heat treatment. The selection of rails for high-density traffic is a matter of considerable controversy and the decision to use the head-hardened special rails was based on the operating experience of the EFVM, in spite of problems associated with their welding.

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The useful life of rails submitted to high traffic densities and high loads per axle is basically determined by the following factors — wear resistance, fatigue resistance, development of surface defects, and resistance to development of corrugations.

The EFVM has developed an intense programme of rail testing characterised by laying the rails side by side on each curve, each curve being of a different radius. As well as laboratory tests, tests were made on the "running line" under normal operating conditions, each type of rail being laid over continuous stretches of considerable distance. It was found that the tests on the "running lines" confirmed observations on the special curve tests.

Of the considerable number of rails tested the best performance was from the head-hardened type of fine pearlite structure. This type was found to be superior when considering all the phenomena which could be observed giving emphasis to wearing and the development of imperfections on the running surface.

The conclusion which Mr Oliveira reached following his wide experience in Brazilian Railways is that to reach a possible economical equilibrium between vehicle and track, the Railways basically depend upon the quality of the rail eventually selected. For lines submitted to high efforts and large loads per axle, the use of high resistance rails, either alloy steel or heat treated, is recommended.

The selection of material destined to the manufacture of rails through laboratory experimentation may be quite practical; however, it is difficult to simulate each and every actual condition of lines in effective operation, thus leaving open the possibility of erroneous evaluation. Thus, the field tests performed under all actual operating conditions are continuously growing in importance and the experience gained through the development of these railways would be invaluable for railways facing similar problems.

Development of an Ore Car

Mr L. C. Smith, Superintendent of the Railway's Technical Department, Hamersley Iron Pty Ltd, outlined the evolution of the unit-train rollingstock used to transport 100-tonne loads of iron ore from Hamersley's twin mines at Tom Price and Paraburdoo, some 290 and 390 km to the port of Dampier.

The initial design was adapted from a well-proven American ore car, but since the beginning of operations in 1966 many design changes have been incorporated into new batches of cars required for successive expansions in mining capacity. In addition some modifications have been made to earlier cars. Many items — extra ladders and stiffening steelwork for example — were found redundant and were deleted to save on cost and, more importantly, tare (empty) weight. The empty weight of the cars is of crucial importance as the most adverse grades are on the return (empty) trip to the mines.

Components such as couplers and the rubber "packages" which transmit the pulling forces to the cars have required some upgrading, to withstand the demands imposed by long (180 car) trains operating in undulating terrain on an intensive basis.

He also discussed the problems affecting the car bodies as a result of the dumpers used to empty the cars and internal corrosion. Structural improvements to body design have enabled car weights to be kept down to about 20 tonnes while incorporatng the slightly heavier premium bogies specified in the most recently delivered cars. The latest contract cars have been designed with some strain-gauging assistance to ensure that allowable stresses are not exceeded.

One experiment of particular interest is the trial of two all-aluminium bodied cars. These were specially designed and weigh some 3.5 tonnes less than their steel counterparts. They were allowed to run without special attention in the ore trains while periodic inspections were carried out to assess the performance. So far, after 250 000 km, the experiment is proving satisfactory. Apart from weight saving, corrosion resistance and high scrap-value (should the worst happen) are the attractions. Initial price is less favourable.

He also described the profound changes made for the 1972 Paraburdoo expansion. Initially cars had been conventionally coupled but the decision was taken to 'marry' cars permanently in pairs. Rotary couplers were fitted at one end of each pair to permit dumping in pairs while leaving the cars coupled in the train.

Fixed bars were used to join the 'married pair' which saved on cost, as did the accompanying simplification of braking equipment. One car, the 'control car', commands the brakes on both itself and its 'slave' car. This reduces the number of control values by half.

The Hamersley Iron ore car has progressed a long way since its inception, and developments will continue, particularly with respect to wheels, bearings, coupler equipment and bogie design to minimise downtime and train breaks.

Forces Created by "Train Action"

Mt Newman Mining Company has carried out five years of computer-aided research into the forces created by "train action"— the waves of motion between ore cars which occur in the 1½ km trains the company uses.

In two papers presented at the conference, Dr James Blair and Mr Ian Thompson, of the Mechanical Engineering Department at the University of Western Australia, gave delegates an insight into the nature of this research and the tremendous progress made. Dr Blair said he believed that the Mt Newman — University research was as advanced as any in the world in this field.

Railways operating trains of the immense length and weight seen in the Pilbara had a constant problem of coupler failures, causing trains to break apart and disrupt traffic on the line. The mechanics of the action which caused these failures were mathematically complex and the length of the trains meant that the drivers were often completely unaware of the tremendous forces building up. A coupler could snap two-thirds of the way along a train without the slightest jolt being felt in the cab.

Dr Blair explained that the research had not only clarified exactly how these immense forces built up, and what could be done to reduce them, but had produced a picture of the constant occurrence of lower, cyclic forces which created fatigue damage in the couplers and made breakages more probable.

Mr Thompson detailed the techniques used in developing computer "models" of trains and showed how, by programming the track profile, users of the system could predict exactly what would happen to the train under any driving conditions.

Draft Gear Inadequacies

Mt Newman Mining Company Design Engineers, Mr Les West, Mr Clem Williams and Mr Alan Kerr, explained how the draft gear, a simple and rugged device designed to smooth out the massive damaging forces on couplers, had become an almost catastrophic failure on the Mt Newman railroad.

Draft gear from several manufacturers of the highest reputation had simply fallen apart on the Mt Newman to Port Hedland line, causing millions of dollars worth of damage and constant disruptions to production. In 1976, when no simple solution to the problem was evident, Mt Newman decided to begin a thorough investigation into the mechanical properties of draft gear. After 2½ years of research and testing, with the assistance of the University of Western Australia, the research group had accumulated a large amount of knowledge of draft gear, some of which was apparently unknown to the manufacturers.

The engineers explained how they had adapted electronic recording equipment to gather information on the various draft gear in operation on the Mt Newman railroad, and had developed computer analysis techniques to extract useful information from the recordings.

Their most striking conclusion was that none of the draft gear on the market — though adequate for other services, including large American freight trains — was suitable for the type of railway operation being run by the Western Australian iron ore companies.

In Mt Newman's case more than 4000 draft gear are in service and considerable design work is now needed to produce a satisfactory solution to a major problem.

Problems in the Pilbara

A Senior Methods Engineer with Mt Newman Mining Co, Mr P.

Peake, told the conference that the four Pilbara iron ore mining companies - Mt Newman Mining, Hamersley Iron, Cliffs Robe River Iron Associates and Goldsworthy Mining - have shipped about 600 million tonnes of iron ore since the early 1960s. In doing so they have initiated the development of ports, towns and railways in one of the harshest climates in the world, where summer shade temperatures regularly exceeded 40°C and rolling stock, rails, ballast, and even wooden sleepers, became too hot to touch. The construction of railway systems in such a harsh climate inevitably involved appreciable technical, operational and social problems.

Mt Newman's railroad could be regarded as typical of those now operating in the Pilbara Region of Western Australia. It was originally designed to carry a maximum of five million tonnes a year, but the company's iron-ore production had escalated rapidly to about 35 million tonnes a year.

In a paper prepared in collaboration with Mt Newman's Railroad Manager, Mr R. Murphy, Mr Peake explained that Mt Newman's railroad had been built to United States standards, with 132RE rail (65.5 kg a metre) spiked to hardwood sleepers with steel tie plates.

He said that gradients and curves were generous by Australian standards, but the combination of reasonably standard rolling stock operating over reasonably standard track to do a far from standard task had soon added technical difficulties to the operating problems.

"An early problem" as Mr Peake explained, " was train loading. The loading system is based on self-choking chutes which deliver a measured volume of ore to each car. But the ore does not drop vertically, so that a longitudinal force is exerted which tends to move the train, giving off-centre loading which overloads one car bogie. As the rail is stressed almost to its yield point even under optimum loading conditions, an overload immediately leads to rail damage.

"To solve this problem many schemes were suggested, such as retarders, rear-end locomotives and positioners, but all would have slowed the loading cycle time. When the railroad was designed any equipment could be chosen, but once a specific operating pattern is in use it is very intolerant to change. To overcome the loading problem it was necessary to keep to the cycle time dictated by the passing sidings.

"The restriction of designing for very high efficiency has been a problem in several situations. It is one reason why we could not change from the type of locomotive we use to a less powerful, but less costly locomotive. It is also the reason why we cannot close the track for maintenance more than once a week. Similarly, it explains the concern at the epidemic failures that have occurred — such as those with draft gears.

"Draft gear failures started after three years of operation and, despite trials of as many different types as possible, we cannot reduce our failure rates.

"During the first major change programmes, which cost about $2 million, the revenue of about 500,000 tonnes of ore was lost. This massive loss, plus a decision to increase the rate at which cars are pulled into the rotary car dumper, led us to request assistance from the University of Western Australia.

"Concurrently, we became aware that nowhere outside the Pilbara were railroads suffering the same problems - in particular, corrugations and low rail crushings. No advice was available from overseas, due to the fact that our operations are unique. The only way out of these problems was to establish basic research programmes which involved Mt Newman, BHP (the rail supplier) and, later, Hamersley Iron.

"Extensive research was also undertaken into operating practices, including testing of the locotrol system used in Queensland and North America. This allows the train crew to control a second group of locomotives in the body of the train using radio, which in turn allows longer trains to be run.

"In addition to these major research projects we have constantly been tackling the less glamorous tasks, such as raising track machine usage, cutting maintenance costs and improving operating efficiency. These tasks are the key to the success of the operation, and exchange of information on these, on research progress and on general concepts, is what the Heavy Haul Railways Conference is all about."

* * *

Steel Sleepers for Heavy Hauls

The technical superiority of steel and the dwindling supplies of timber — the traditional material used for railway sleepers — will lead to general use of steel sleepers throughout Australia, according to Dr J. Brown, a Research Officer with BHP's Melbourne Research Laboratories. He believes that steel sleepers will be used in place of the familiar timber types which now comprise about 98 per cent of all Australian track.

"Alternative sleepers are required as timber of appropriate quality is becoming more difficult to procure and therefore more costly. Australian timber reserves are dwindling and increasing emphasis is being placed on using that timber for more essential applications, such as furniture".

Dr Brown pointed out that steel sleepers were technically superior to timber sleepers and had a scrap value which, after forty years of life, was usually greater than the purchase value.

The development of the steel-sleeper system had been undertaken at the Melbourne Research Laboratories of BHP and included engineering design of a beam section with the shape of an inverted trough, attachment details to enable the rails to be held to the sleepers by proprietary rail-fastening systems, and a pad for electrically insulating the rail from the sleeper for those applications where train signalling was performed by electrical signals passing along the rails.

Prototypes of the sleepers had been tested in the laboratory under simulated in-track loading which included vertical axle-loads, lateral wheel-loads, interaction between axles on train vehicles, and dynamic effects. The tests had been performed on panels of full-size track components in a high-speed test machine measuring 6 metres by 6 metres and weighing 70 tonnes. Following the tests, the sleeper designs were optimized.

Of the four sleeper types comprising the range, the first to be developed fully and manufactured was the sleeper for heavy-haul railways, such as the one operated by Mt Newman Mining Co. for transporting iron ore in the North West of Australia.

The heavy-haul sleeper beam was rolled at the BHP Whyalla Steel Works, cut into sleeper lengths and

pressed to form the spaded ends to lock the sleeper in the track ballast bed, with two bends to provide correct inclination of the rail and the housings for the rail fastener.

So far, 2500 of the heavy-haul sleepers had been installed in the Mt Newman track and a thorough investigation of their performance was being made. It covered measurement of strain and stress in about twenty sleepers at about 200 points, track deflection using a laser system, and pad insulation.

Completion of development and testing of sleepers in the range was planned for 1979 and a brochure describing the range, technical factors and economic considerations would be produced.

Reducing Track Maintenance Costs

The general opinion of "the permanent way", as it is termed by railwaymen, would be that it has changed very little over time. But in real terms, changes in design have occurred continuously, although at times imperceptibly to the casual observer.

Mr M. O'Rourke, a Research Officer with BHP's Melbourne Research Laboratories, pointed out that while the three components of the permanent way — the rails, sleepers and ballast — have remained basically the same, several differences in their use were evident.

The size of rails had been increased and their chemical composition altered. Sleepers were now larger and placed more closely together, while concrete and steel sleepers were being used in place of timber. The depth of ballast supporting the sleepers and rail had been increased accordingly.

The improvements to the structure of the permanent way had been brought about by a steady but continual increase in the size and weight of vehicles carried, and until recently the traditional design methods used by railway engineers throughout the world were sufficient to take these factors into account. However, with the advent of the heavy-axle wagons of 120 tonnes gross weight required for economic handling of Australian iron-ore exports from the Pilbara, this situation had been changed dramatically.

Permanent-way maintenance costs due to higher sleeper-replacement rates, break-down of ballast and reduced rail life had meant that traditional design procedures, which did not consider track maintenance costs, now had a limited applicability. Accordingly, the BHP Melbourne Research Laboratories had, in conjunction with Mt Newman Mining and Hamersley Iron, undertaken a programme to determine means of reducing track maintenance costs by improving the present railway-track design techniques.

"The first step in this programme," said Mr O'Rourke, "was to examine the current design methods and pin-point the areas in which they were inadequate. The major factor to emerge was a requirement for the deformation of the track, which causes rail 'out-of-straightness' and wave-like vehicle motions, to be included in the design method.

"Relationships between the capital cost of track components and the maintenance costs incurred in their selection are also under analysis. Because of the complex nature of these problems no simple and immediate solution is available. A step-by-step approach involving both theoretical studies and extensive experimental work on the Mt Newman and Hamersley Iron railroads has therefore been pursued."

He said the theoretical studies to this stage had examined the contribution of the ballast to the permanent set or "out-of-straightness" of the track caused by high loadings. This had involved a review of granular material properties, including sand and road aggregate which behaved in a similar fashion to ballast and the subsequent development of a model to predict permanent set in the track.

Track Component Development Hamersley Iron Railway

Since the construction of the Hamersley Iron Railway in 1966, the 288 km section of track from Mount Tom Price to Dampier has handled over 400 million gross tonnes of heavy-axle unit train traffic.

In addition of these heavy tonnages, the track has been subjected to temperatures ranging from 48°C in the summer months to a low of about 0°C and to the effects of high winds and torrential rainfalls associated with frequent cyclones. These extremely arduous operating conditions have necessitated major upgrading programmes and revision to cope with the deficiencies in the original design.

The original design was based on expectation of a relatively low annual tonnage and the prevailing theories and materials available at that time were employed.

An increase in the depth of the ballast ranging from 20 cm to 45 cm below the sleepers was required to provide stability and adequate support in areas subject to heavy rainfall.

The track was originally laid with untreated 8ft West Australian hardwood sleepers. This led to severe weathering with a high incidence of end-splitting and a loss of holding power via the fastenings. In conjunction with the introduction of a longer-treated Malaysian hardwood sleeper, an easily-removed and superior gripping type of rail fastening was installed.

In 1973, Hamersley embarked on a test programme involving various types of concrete sleepers. These have proved highly successful from the standpoint of reducing maintenance costs, and Hamersley are to commence complete concrete resleepering of the Tom Price to Dampier section early in 1980.

* * *

130lb/yd 150lb/y

The prevalence of high wear on curves due to the increasing annual tonnage led to replacement of the original 59 kg/m rail with a larger continuously welded 68 kg/m rail section but rail wear continues to be a problem. In one curve which is 1200 metres long, the rails last only 18 months. To overcome this problem, Hamersley are field-testing alloy rails and head-hardened rails. These recent advances in rail steels promise greater strength and wear resistance and will, it is hoped, actually double the life of the rail.

Numerous other changes have been made in welds, insulated joints, and points and crossings. It has been found necessary to monitor the performance of the track continuously and assess various materials and techniques. To this end, Hamersley are building a track geometry measuring car, and are continuing research into track components in an effort to improve existing standards.

This submission was made by N. R. Geddes (Research and Development Engineer), B. H. Longson

One of the "star attractions" at the Heavy Haul Railways Conference was a computer set-up with a display terminal that allows operators to feel that they are actually driving one of the huge trains used on the Pilbara railways. Delegates to the conference were able to "drive the train" by operating control handles and watching a moving image of the track on a cathode-ray oscilloscope.
As different techniques of driving were tried, the operator could see what forces were being created along the train by looking at a graphical display on another video unit.
The computer, known as a "real time ore train dynamics simulator", has been set up by Mt Newman Mining Co. and the University of Western Australia. The designers see it as an exciting development in railway technology, being potentially both a major research tool and a driver-training aid similar to the Link trainer used in aircraft.
Future development of the machine could be an important "first" for Western Australia.

From the left: Messrs J. H. de Silva Oliviera, Federal Railways Director of Special Projects, Brazil; E. C. Matos and E. D. de Paula, Control Technicians, and A. C. de Azeredo, Engineer, of the Intervale Ferroviaria SA, Brazil; and A. B. Holm, Westrail's Chief Civil Engineer watch Prof. J. Elbrond (seated) Engineering Professor of the Department of Mineral Engineering, Ecole Polytechnique, Montreal, Canada, operate the new computer train simulator.

(Senior Research and Development Engineer), and P. J. Dwyer (Assistant Research and Development Engineer), of Hamersley Iron Pty. Ltd.

Preventing Heavy-Haul Derailments

The trains operating on the Hamersley railway are among the largest unit trains in the world, and each derailment usually causes damage in excess of a million dollars.

Thorough and detailed investigation of every major derailment has been carried out to determine the exact cause and this information has been used to develop detection equipment or revise maintenance procedures to reduce the possibility of future derailments.

Major causes include broken wheels, broken axles, overheated bearings, washaways, broken rails, and even poor train handling by the driver. Special detection devices which have been developed include infra-red sensors to detect overheated wheels or bearings or objects dragging under moving trains.

A combined induction and ultrasonic test car was introduced into service in 1977 to detect internal defects in the rails. Small internal rail defects usually propogate in time causing rail fractures under passing trains.

Portable ultrasonic testers are also used to detect internal defects in wheels and axles. Defective wheels or axles can then be replaced before fracturing in service.

The high cost associated with derailments justifies expenditure on sophisticated equipment and research programmes in an attempt to reduce the exposure to derailments.

This submission was made by W. R. Fahey (General Superintendent, Railways Track), E. H. Williams (General Superintendent, Railways Workshops), I. Haby (Formerly Chief Trainmaster), and W. J. Adamson (Formerly Superintendent, Railways Signals and Communications), Hamersley Iron Pty Ltd.

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Replacement Track Structure for Westrail's Standard-Gauge Line

The standard-gauge (1435 mm) railway between Kwinana and Koolyanobbing in Western Australia was opened to traffic in 1967 as a general freight railway carrying some bulk traffics at higher axle loadings. Increases in the tonnages of bulk traffics at the high axle loading accrued more rapidly than had been foreseen, with two results. Firstly the relatively light rails and sleepers deteriorated more quickly than expected. Secondiy, while it also carried general freight and passenger traffic, the railway became primarily a heavy haulage line.

In determining the replacement track structure configuration, Westrail engineers were required to show formally that the proposed form was the optimum technical and economical solution, as a basis for submissions for funds. This required investigation and evaluation of alternatives in a technical area in which standards have been set historically from experience on the judgement of individuals. As there are no rational design techniques for the complete track structure, this was a rare opportunity.

The formation was well compacted and was designed to a high standard of alignment and profile. Some attrition of the crushed rock ballast had occurred but this was not considered serious enough to warrant ballast cleaning or replacement. So, the investigation centred on type, dimension and spacing of sleepers, types of fastenings and rail size.

Investigations were undertaken to determine residual life of the existing sleepers and rails. The sleeper life was determined for each main section by statistically controlled inspection and classification of samples. Rail-life investigation involved wear measurement, determination of fault trends and comparison with life data from other railway systems. The profile of life expiry of rails and sleepers formed the basis for the track rehabilitation programme.

Alternatives for resleepering were studied and it was concluded that only timber and prestressed concrete sleepers were practical options. As the existing 229 mm x 114 mm x 2438 mm timber sleepers were shown to be inadequate in size, a larger timber sleeper was designed. A pre-stressed concrete sleeper was also designed in outline to suit the characteristics of the railway. Comparative technical and economic evaluations were made (including fastenings) and it was shown that concrete sleepers were the best investment. Alternative tenders were called for timber and concrete sleepers and these confirmed the study findings.

To determine the optimum rail size it was necessary to evaluate alternative rail size/axle load combinations. Establishing the axle load to apply to a specific rail size required a special study of the fatigue life of rails under flexural stresses and of the strength of rail steels so that rail head damage would be minimal. Economic evaluations of a range of technically selected rail size/axle load combinations were made and showed that 60 kg/m rail with 25 tonne maximum axle loads were the economic optimum. 132 lb/yd

This submission was made by J. F. Hoare (Planning Engineer) and A. F. Payne (Track Structures Engineer), of Westrail.

Kwinana-Koolyanobbing: the Basis of Evaluation

In the early seventies, when increasingly strong evidence indicated that the Kwinana-Koolyanobbing section of the Trans Australia Railway was nearing the end of its physical and economic life, financial, economic and technical analyses were undertaken to determine what should be done about it.

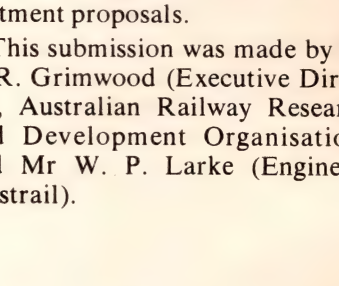
The technical analysis determined schedules of asset life expiry under different operating conditions and identifizd suitable track-standard alternatives and maximum axle-load/speed combinations. The financial analysis would be familiar to those operating in the private sector; it determined the financial worth of the project to Westrail as an organisation. The economic analysis extended the familiar technical/financial analyses to enable the perspective of the community at large to be taken into account.

The prime objective of the evaluation was to determine the mode, or modal combination, which would meet the transport demand in the most economically and technically efficient way. Of all the feasible combinations, including non-rail options, an upgraded (and not simply replaced) rail link was shown to be economically and technically superior to other alternatives. The evaluation also determined that the optimum track standard would utilise 60 kg/m rail with concrete sleepers and operate with a 25 tonne axle load maximum. For optimal timing, investment should commence as soon as possible and the penalties for investing at non-optimal times were determined. The project was shown to be financially an attractive investment to both Westrail and its money providers and it was shown that the funds, in equity, should come from the Federal Government.

Further, it was concluded from Government reaction that the case was instrumental in obtaining commitment to the project, which has now commenced. It is conjectured that the broad approach taken in these evaluations will become a normal requirement of commercial investment proposals to Governments necessarily concerned with the community at large as well as the financial viability of its instrumentalities.

The implication for Government-owned railway systems in Australia is that it will no longer be adequate to prepare an evaluation case on the basis of technical excellence or adequacy. It is certain to become increasingly necessary to analyse fully the financial impact and broader economic issues. In this respect Westrail's case for rehabilitation of the Kwinana-Koolyanobbing railway recognises the need for change and sets the pattern for future investment proposals.

This submission was made by Dr P. R. Grimwood (Executive Director, Australian Railway Research and Development Organisation) and Mr W. P. Larke (Engineer, Westrail).



Canada's Massive 2000 km Coal Haul

An aerial view of the 236-acre McKellar Island site of Thunder Bay Terminals Ltd. The marine berthing facility is in the foreground and the partly-filled coal beds are shown top centre.

On 14 September, the discharge of 100 tons of western Canadian coal from a CN rail car marked the official opening of a new bulk-storage terminal at Thunder Bay, Ontario, and the initiation of a new energy transportation programme spanning the continent. Immediately afterwards, a CP Rail train of 105 cars, which had travelled 2000 km from a mine near Corbin, in British Columbia, proceeded to unload. It was one of seven new coal trains put into regular service by CP Rail and CN.

Vast coal deposits are known to lie beneath the Rocky Mountains foothills. Study of the market potential for this coal began more than ten years ago; and by the early 1970s Japan's growing needs had initiated the export of large quantities of it. At the same time, serious doubts had arisen concerning the dependability of the US coal regions as the main source of supply for eastern Canada.

President Carter's National Energy Plan has since called for a doubling of production by 1985, in order to reduce American dependence on foreign oil, but labour problems and environmental pressures may cause the US industry to fall short of increasing domestic needs.

By 1973, CN and CP Rail had completed a thorough evaluation of the transport of western Canadian coal to eastern Canada. Significant progress had also been made in rail-car design, in adjustments to existing rail installations to handle longer trains, and in the assessment of locomotive power requirements. Preliminary planning for bulk-handling facilities had also been undertaken.

When Ontario Hydro approached the railways in 1974 concerning the feasibility of moving western Canadian coal to power-generating plants in Ontario, much of the groundwork had already been undertaken. The rail-water move was quickly decided upon as the most suitable, and the subsequent agreement provided for Ontario Hydro to underwrite the capital investment in the new rollingstock, including locomotives, that would be required to haul the coal across to the shores of the Great Lakes. The big haul has now begun and over the next fifteen years Ontario Hydro will buy each year two million tons of bituminous coal from a new mine at Coal Valley, Alberta, and half a million tons from an existing mine near Corbin, in British Columbia. This latter purchase will increase to 700,000 tons early in 1980.

The coal is destined for a generating station at Nanticoke, on the north-east shore of Lake Erie. The first stage of the journey will be by rail to Thunder Bay, on Lake Superior; the second stage will be by Great Lakes freighters.

CP Rail's 105-car unit train loads thermal coal at the Byron Creek mine in Corbin, B.C., before travelling 2,000 km to the new Thunder Bay Terminal. The train will make the 4,000 km round trip, carrying 10,000 tonnes of coal, in six days. CP Rail will haul 20.5 million tonnes of coal to Thunder Bay over the next 15 years.

In addition, haulage of a million tons of lignite a year from a mine near Bienfait, Saskatchewan, will begin in 1979 for use in the Thunder Bay generating station, whose extension is scheduled to open in 1980.

Both CN and CP Rail will move the coal to Thunder Bay. That from the Coal Valley mine will be carried by four CN trains, each of 98 open gondola cars hauled by four 3000 hp diesel-electric locomotives. Each car carries 100 tons of coal; and the CN trains are scheduled to cover the 2250 km route and return in seven days.

CP Rail will use two trains to transport coal from Corbin. Over the steep mountain grades of British Columbia, each train will have four locomotives at its head, with two locomotives and a robot car in the middle of the 105-car rake. The mid-train power will be removed when the train reaches the open prairie. The CP trains are scheduled to cover the 2092 km route and return in six days.

On both systems track has been upgraded to carry the increased loads, and sidings have been extended. A bypass takes the CN trains round the marshalling yards in Winnipeg.

CP Rail will also move the lignite from Bienfait, Sask., using one train with three locomotives and 111 cars which will cover a 1200 km route with a four-day turnaround.

In all, 36 locomotives, 800 cars and three robot cars have been built specifically to meet Ontario Hydro's needs — the locomotives by General Motors of Canada Ltd., London, Ontario, and the cars by National Steel Car Co. Ltd., Hamilton, Ontario. The total value of the equipment exceeds $50 million.

An impressive $70 million coal-terminal facility is nearing completion at Thunder Bay on what was scrub and swamp land; and Ontario Hydro has a 15-year contract, with renewal options, for the use of the facilities.

Nearly three million tons of coal will move through the terminal each year, bound for Nanticoke; stockpiling will go on continuously, and shipments across the lakes will be made during a season of eight to nine months.

Almost half of the annual throughput could be stored over the winter; and the terminal could expand its operations on short notice, and with comparatively little capital expenditure, to handle six million tons a year.

Note Short Rail, Staggered

Over the next 15 years, CN will move 27.3 million tonnes of coal for Ontario Hydro from Coal Valley, Alberta, to the new multi-million dollar Thunder Bay Terminals Ltd. facility on McKellar Island. The trains involved in this movement will consist of four 3,000h.p. diesel locomotives and 98 steel rotary-dumper cars, each of 91 tonnes capacity. One of these trains is seen being loaded at Coal Valley.

At the time of the official opening, twenty trains had already passed through the terminal, and nearly 200,000 tons of coal were on the site. Transport across the lakes begins in November 1978.

Trains arriving at the Thunder Bay terminal move on a 4 km loop to an unloading facility which includes a thaw shed, where the cars can be heated in temperatures of 82°C (180°F) in winter to ensure that frozen coal breaks loose.

A semi-automatic indexer takes over from the train's own diesel power and positions the cars, one by one, in the dumper building. The dumper, a huge circular clamp, grasps each car in turn and rotates it through 160°; the contents fall into a hopper. Rotary couplings eliminate the need to uncouple the cars during this operation, and the entire train proceeds through the dumper building until all the cars have been unloaded.

The hopper drops the coal onto a "grizzly", a series of steel bars which break the fuel's fall onto a conveyor belt. This carries the coal at speeds of up to 4000 tons per hour to a huge stacker which travels the length of the site on a 750 m track to pile the coal.

Another machine on the same track reverses the process, when required, to reclaim the coal, which is carried by conveyor to a huge surge bin and then to the ship loader, which can fill a 220 m (730 ft) lake freighter with some 30,000 tons of coal in about eight hours.

The present berthing facilities could be modified to handle 304 m (1,000 ft) vessels, each with a deadweight capacity of 50,000 tons.

The new terminal incorporates extensive environmental control systems to minimise wind- and water-borne coal dust. Semi-automatic water-spray devices control dust in dry conditions when the coal is dumped, when it is being moved on the site, and when it is being stored. Water that drains from the coal after natural precipitation, or from spray systems, runs into settling ponds and is reused in the system. The 14 ft high loop track itself forms a dyke around the entire complex, ensuring that no run-off leaves the site.

Electronic controls and a computer system monitor and service the terminal on a 24-hour basis.

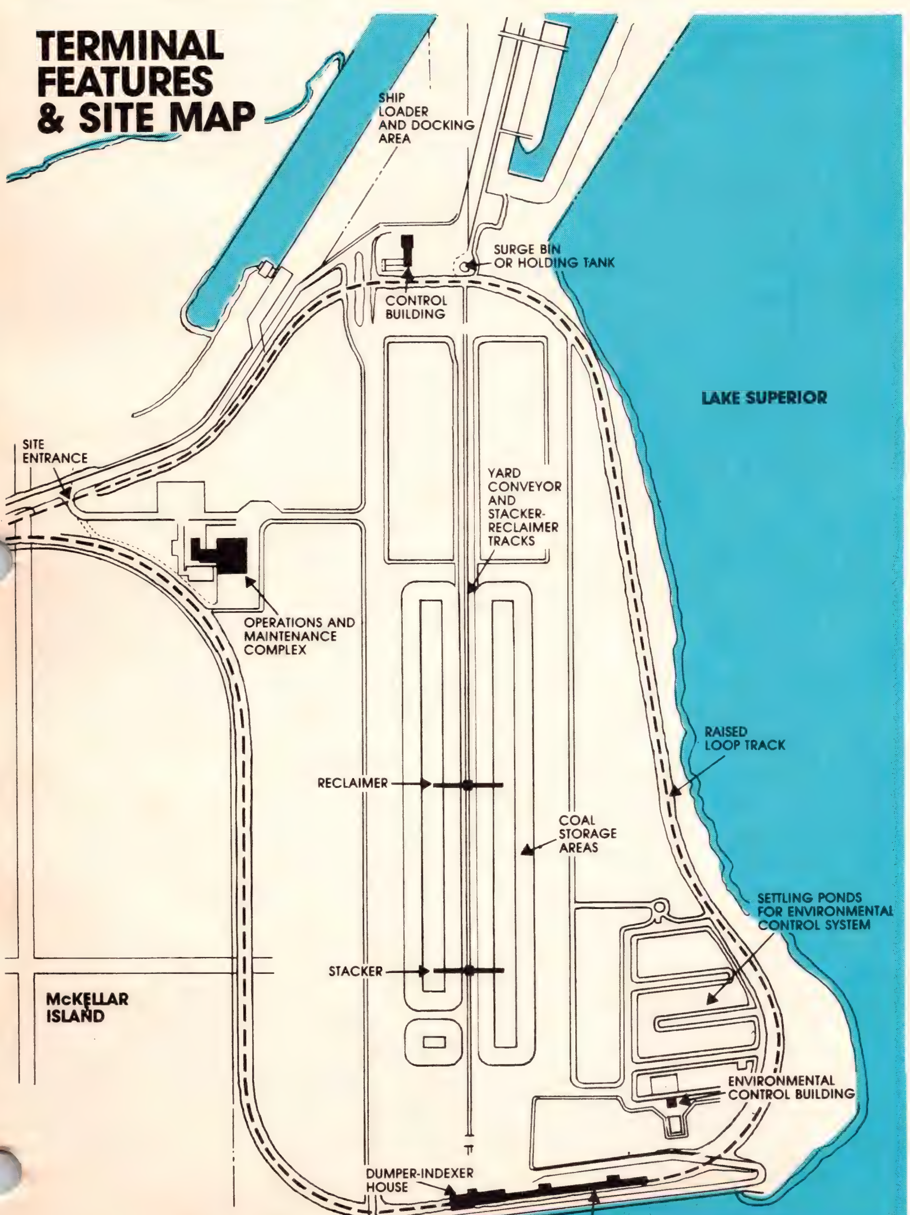
When the first regular shipments arrive at Nanticoke in the spring of 1979, Ontario Hydro will have completed a $26 million installation of blending facilities, to mix the Western Canadian coal with high-grade Pennsylvania coal.

Western Canadian coal cannot be burned alone in Hydro's boilers, which were designed for the high heat-content of US coal, so extensive tests were carried out to determine the best way to use the western coal. It was decided that the final blend should be at least fifty per cent American coal, with the remainder Canadian.

The two varieties are stockpiled separately and conveyed to separate storage silos. Feeders allow the coal to drop from the silos onto a common belt and variable drive speeds allow a stream of blended coal up to 6000 tons per hour to be conveyed to the station fuelling bunkers.

The Western Canadian coal system is a capital intensive project, so the more industries that use the system, the more economical its operation will become. Also the automated nature of the system will make operating costs less sensitive to inflationary pressures.

A train loaded with bituminous coal from Western Canada in the dumper house at Thunder Bay Terminals. The semi-automatic indexer unit, which positions the cars in the rotary dumper, is shown upper left.



Best use of the rail system will occur around three million tons a year for each railway. The terminal at Thunder Bay will become more economical as it approaches its maximum capacity of six million tons.

There seems little doubt that the improved bulk rail and water transport system, ushered in by Ontario Hydro's fuel requirements, will improve the west-east flow of bulk commodities and perhaps spark the interest of other eastern industries in western coal.

Ontario's Hydro's Vice-President of Resources, Milan Nastich, summed up the corporation's optimism when he told the 27th Canadian Conference on Coal in 1975: "We believe that establishment of a basic movement of coal from Western Canada to the Great Lakes is not just of benefit to Ontario. It is also in the best interests of the western provinces and Canada as a whole."

Reducing dependence on US coal means a marked favourable change in the balance of trade for Canada, and the investment of $400 million in the western Canada coal-supply system has stimulated employment in four provinces.

Thunder Bay, McKellar Island — terminal features and site map.

Above and right: Loading at Bowen

Below: Transferring RACE containers to PTC wagons at Clapham, Brisbane

Long-distance Container Haulage of Fruit and Vegetables

As with every railway system in Australia, Queensland Railways is making major efforts to maintain its place in surface transport and over the past twelve months or so, much attention has been directed to the use of containers for long-distance freight. A real tussle for supremacy is being waged as the railways strive to increase freight consignments bound for southern markets and others heading north from southern states.

At the moment, the emphasis is on the shipment of fruit and vegetables from North Queensland to Sydney and Melbourne. Railways of Australian Container Express — RACE — containers are being used extensively to move tomatoes, corn, melons and many other produce lines. They house wooden-based pallets on which cartons of southbound fruit and vegetables are stacked. A container can take 10 pallets each loaded with 100 cartons.

In association with the use of these containers on loan from the New South Wales Transport Commission, equipment has been modernised and performance improved. Over and above the benefits of palletisation, the real advantage to the producer is in the reduction of transfer time from Queensland to New South Wales trains in Brisbane, together with a minimum need for manual handling at both loading and offloading centres.

Up to six hours are saved at Brisbane's Clapham Junction goods yard where large gantry cranes lift the containers from one train to another. In one lift for instance, up to 1000 cartons of tomatoes can be transferred.

To compete with the interstate road hauliers through the use of the RACE containers, the Queensland Railways had first to face the task of modifying a number of bridges between Brisbane and Cairns. The old-style arch bridges built before the war were too low for the containers to pass through, so the Railways outlayed some half a million dollars altering the structures.

Rail containerisation of interstate fruit began about twelve months ago, but really got under way in force earlier this year. It has become so intensive that up to 400 RACE containers a day have been in use within the Queensland system.

To demonstrate the advantages of the containers to present and potential users in North Queensland, a special field-day was held recently in Bowen, a major supplier of small-crop produce for southern markets. It was a joint promotion by the Queensland Railways, the New South Wales Transport Commission, the Committee of Fruit Direction and Marketing (COD) and the Bowen Fruitgrowers Association.

Representatives from the Railways of Australia Committee and from industries which supply packaging equipment, were also present.

The programme included exhibits of a number of containers, audio-visual displays, and visits to local farms to see harvesting, packing and palletising.

Queensland's State Transport Minister, Mr Ken Tomkins, who was present, pointed out that "Containerisation offers growers the best means of presenting their produce to southern markets in off-the-farm condition. Not only does it reduce transfer time to New South Wales rail wagons, it keeps damage to produce at a minimum by eliminating the need to handle individual packages during transhipment".

One fruit in particular which is benefiting from the new system is the watermelon. In the past, watermelons have been extremely difficult to handle, on a one at a time basis. Now, up to ten tons can be lifted by the gantry crane, saving many hours of manual labour and eliminating risks of breakages and other damage.

The shipment of bananas from the north has likewise been improved.

Bureau of Transport Economics

Transport Outlook Conference, 1978

The 1978 Transport Outlook Conference, held in Canberra on 19-20 September 1978, brought together some 300 high-level executives from industry, the trade union movement, the academic world and government. It was the second conference in the Outlook Series, the first of which was held in 1975.

The major objectives of the Conference were:

- to provide indications of the short- and medium-term outlook for the transport sector;
- to increase awareness of the major factors which influence transport supply and demand;
- to provide a forum for high-level interaction on questions of major significance in transport;
- to improve communication between all areas of transport management in Australia.

The Conference was chaired by Mr G. K. R. Reid, Acting Director of the BTE. Following Mr Reid's welcome to delegates, Mr C. C. Halton, Secretary to the Commonwealth Department of Transport, delivered the keynote address. Mr Halton stated that as well as providing a forum to identify and discuss transport problems, the Conference also provided an opportunity to discuss some of the basic perennial conflicts between transport objectives and other social and economic objectives. He expressed pleasure at the improving level of debate and advice on the various issues.

Discussion commenced with the presentation of two major outlook papers. Prepared and presented by the BTE, these summarised the short-term outlook for passenger and freight transport. The major factors expected to influence this outlook were identified, and used to assess future activity levels.

The afternoon of the first day was devoted to a Symposium on 'Government Regulation of Transport Activity in Australia'. The discussion was led by a panel chaired by Dr J. H. E. Taplin, a former Director of the BTE and Deputy Secretary of the Department of Transport, and currently lecturer in economics at the University of Adelaide. The panel members comprised:

- Mr A. S. Reiher, Chief Commissioner, Public Transport Commission of New South Wales,
- Professor J. E. Richardson, Commonwealth Ombudsman,
- Mr B. R. Redpath, Managing Director, Mayne Nickless Ltd,
- Mr C. H. Fitzgibbon, Federal Secretary, Waterside Workers Federation,
- Captain J. G. Evans, Chief General Manager, Howard Smith Industries Pty Ltd, and
- Mr K. R. Hamilton, General Manager, Qantas Airways.

The aim was to develop a statement of the impact of government regulation on transport and to point out desirable directions for possible change.

On the morning of 20 September, the Conference divided into simultaneous sessions, covering five major market segments of the transport sector. A paper by an expert in the field was delivered to each session. The papers were:

- *Urban Passenger Transport,* by Professor R. A. Layton, School of Marketing, University of New South Wales,
- *Non-Urban Domestic Passenger Transport,* by Mr G. W. L. Tucker, Executive Director, Australian National Travel Association,
- *Australian International Passenger Transport,* by Mr J. C. Dawson, Planning Director, Qantas Airways Ltd,
- *Domestic Freight Transport,* by Mr L. E. Marks, Executive Director Transport, Brambles Holdings Ltd,
- *Australian International Freight Transport,* by Dr K. Trace, Senior lecturer, Faculty of Economics and Politics, Monash University.

The sessions enabled in-depth discussion of the issues confronting each major area of activity. The issues confronting each segment were then brought together for general debate in the following plenary session, which also served to highlight the areas where the various transport segments were complementary or competitive. The plenary discussion was led by a rapporteur from each of the segment sessions and was chaired by Mr J. E. Knox, Director General of Transport, Western Australia. Each rapporteur gave a five-minute summary of the major points raised in his segment session, which were then opened to discussion from the floor.

The afternoon consisted of a plenary session in which a panel, chaired by Mr C. C. Halton, brought out many of the issues raised in the preceeding discussions, and opportunity was provided for statements, both from the panel and the floor, on the outlook for Australian transport.

In his closing report, the chairman, said that the main message he saw coming out of the Conference was the effect of institutional constraints on retarding the adoption of technology and other innovations in the transport industry. Mr Reid added that it did not follow, however, that change is not occurring. Opportunities for improvements in transport are mostly of a micro nature; they are incremental and gradual and are occurring continuously. The process is evolutionary and, with a few exceptions, significant change is not apparent in the short, 3-5 year time horizon such as that covered by this Conference. On regulation, Mr Reid stated, in agreement with comments made in the Symposium by Mr Reiher, that discovering and communicating the relevant facts of any matter to all interested parties is the best way to achieve a sensible and flexible regulatory framework. He also said that a major objective of the Conference was the improvement of information flows, and to this end it had been a success. In addition, he noted that it seemed to be the general Conference consensus that transport, as a service industry, must regard the interests of the consumer as paramount.

An official dinner was held on the Tuesday evening, at which the Minister for Transport, the Honourable P. J. Nixon, addressed the delegates.

A report containing the papers presented at the Conference and summarising the various discussions is being prepared.

Westrail's Concrete Sleeper Programme

Stockpile of concrete sleepers being weathered outside the factory at Meckering.

Production of mono-block prestressed concrete sleepers is now in operation at John Holland's manufacturing plant at Meckering, in readiness for the resleepering and rerailing of the Kwinana to Koolyanobbing standard-gauge railway (see *Network,* May, p.19 and July, p.29).

A report prepared by Westrail's Engineers in August 1976 showed that this railway, with the densest traffic in the Westrail system and linking Perth with the Eastern States, was in urgent need of rehabilitation.

The track had been constructed between 1963 and 1967 using Western Australian hardwood sleepers, 8′ long by 9″ wide and 4½″ deep, spaced at 2′ centres with 47 kg/m rail, double-shouldered steel sleeper plates, ¾″ sq. dogspikes, and "Fair" type rail anchors.

This standard, which was nominated in the agreement between Western Australia and the Commonwealth Government, has proved to be too light for the gross tonnage and axleloads operating on this section.

Annual traffic tonnage has increased considerably over the original anticipated figures and the line is now carrying 10-12 million gross tonnes per annum. Over 50% of the traffic is hauled in bulk at maximum axleloads which, due to the deterioration of the track, have been reduced from 23.5 tonnes, to 22.5 tonnes for iron ore traffic, to 22.0 tonnes for grain traffic, and 21.0 tonnes for all other freight. There have also been reductions in speed.

Since the cessation of interstate sea freight, the railway has increased in strategic importance and traffic forecasts are for an annual gross tonnage increasing to 15 million tonnes.

From the various studies carried out by Westrail's Engineers, it was finally agreed that the new track structure would use the new 60 kg/m Australian Standard rail with concrete sleepers and proven resilient type fastenings.

The problem was to select a concrete sleeper that would be suitable for Western Australian conditions. Although concrete sleepers have been developed by a number of countries over many years, a sleeper accepted world wide as a preferred type has not yet emerged. This is intended not as a criticism of existing designs, but rather to convey that sleepers must be designed to suit the loading and maintenance conditions pertaining to the railway under consideration.

An examination of systems round the world revealed use of concrete sleepers in both the mono-block and duo-block form. The mono-block sleeper predominated and although there were considerable lengths of track with the duo-block sleeper there were very few railways using this type of sleeper for new or total replacement work. The mono-block sleeper appeared to offer advantages in regards to maintaining alignment and top, especially with heavy axle-block trains and, in keeping with world-wide preference, was selected as the type for use in the rehabilitation work.

* * *

There seemed to be two design philosophies for prestressed concrete sleepers, particularly in regards to the mid-sleeper section — one resulting in a relatively flexible sleeper, the other in a much stiffer sleeper. The F27 concrete sleeper used by British Rail was seen as an example of the more flexible type and is the sleeper used by the Australian National Railways. The design does not allow for distribution of support over the total length of the sleeper, no doubt on the assumption that the track would be tamped before this condition was reached. The result is a sleeper with a relatively small mid-sleeper moment of resistance. On British Rail, with its intensive mechanised track maintenance, this sleeper is performing satisfactorily, but under conditions pertaining to Westrail's standard-gauge main line, where it would be neither practical nor economically justified to have such intense maintenance, the use of this type of sleeper could lead to problems with mid-sleeper cracking.

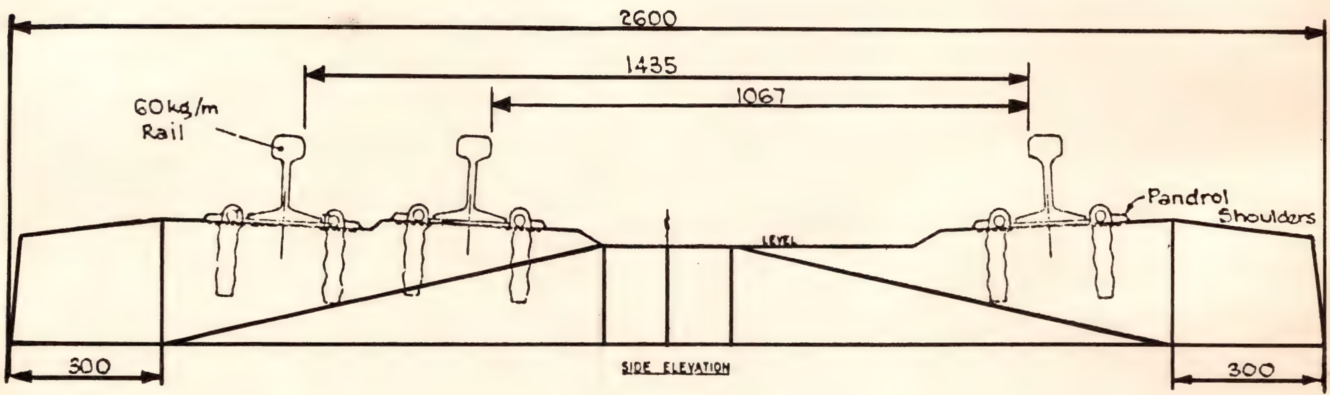
The alternative design approach, considered more suitable for Westrail, allows for distribution of support over the total length of the sleeper in accordance with current AREA recommendations and was adopted for determining mid-sleeper detail design parameter.

Analysis of the sleeper section under the rail was carried out by assuming sleeper support over the tamped length in accordance with common practice. A comparison of moments of resistance between Westrail's design and the design of other standard-gauge railway systems is shown in the table.

* * *

Comparison of Moments of Resistance

Sleeper Type	*Moments of Resistance*		*Ratio* $\frac{Mr}{Mc}$
	Rail Seat (Mr)	*Mid Sleeper (Mc)*	
Westrail-25t A/L	17.5	16.0	1.09
B 70 German-25t A/L	15.1	9.9	1.53
British Rail F27-25t A/L	23.0	9.0	2.56



Early enquiries revealed that tenders for a contract, involving both design and manufacture of concrete sleepers, would be submitted by most of the world's major concrete-sleeper manufacturers. Problems were anticipated in evaluating tenders unless all designs were to a common basis and for this reason, and to ensure that all sleepers were to Westrail's general requirements, the following design parameters were specified — maximum dynamic sleeper plate load, minimum moments of resistance at the rail seat and mid-sleepers, sleeper length, width of the underside of sleeper and maximum depth under rail. A special feature of design was the dual-gauge sleeper. To our knowledge, no railway system in the world at that time was using or had experience with a dual-gauge prestressed concrete sleeper. The figure above shows in general outline the concrete dual-gauge sleeper considered for resleepering the railway.

Selection of a fastening system for the concrete sleepers eventually came to a choice between "Pandrol" and the "Fist-BTR" system. Both systems were proven and there appeared to be little difference between their performance; for this reason tenders were called for both systems.

Tendering for the design and production of 540,000 standard-gauge sleepers and 420,000 dual-gauge sleepers closed on May 26, 1977, tenders being received from Australian companies associated with international companies to provide the necessary concrete-sleeper design and production expertise. Designs were offered from companies in the United Kingdom, Sweden, France, Germany, United States of America, South Africa and Australia.

The tender finally selected was that offered by John Holland (Constructions) Pty Ltd in association with Grinaker Precast Pty Ltd from South Africa. Production is proceeding satisfactorily in the factory established at Meckering.

* * *

All standard-gauge sleepers are being produced for the "Fist-BTR" fastening system, which was shown to be the most economical. The dual-gauge sleeper order was modified to provide 170,000 sleepers for the "Pandrol" system, with 250,000 using the "Fist-BTR" system. The "Pandrol" system is to be installed on the Northam to Forrestfield section where 64% of the track length is curved and subject to much heavier rail wear. This fastening system was preferred because of its location on top of the sleeper, thus facilitating the renewal of the rail.

Production at Meckering in the factory constructed by John Holland (Constructions) Pty Ltd is carried out using six lines, each of 40 sleepers long by four sleepers wide, giving a total output of 960 sleepers daily.

The standard-gauge sleepers are 228 mm deep and are of the waisted sleeper shape to reduce the concrete at the centre of the sleeper. Each sleeper is prestressed using sixteen 5.08 mm dia 1700/1850 MPa UTS stressing wires produced by Australian Wire Industries using the Van Moos-BBR type indent which has been shown to have excellent bond characteristics.

Installation of the concrete sleepers will be carried out under another contract, let to Roberts Construction Australia Pty Ltd, and is scheduled to commence from Avon yard working towards Merredin, at the beginning of May 1979. It will see the introduction into Australia of the Matissa P811 tracklaying machine that has been developed by Valdeterra working on the Italian Railway System and is considered the most suitable machine in the world today for completely rebuilding a railway track under traffic-operating conditions with limited track occupancy times.

It is confidently predicted that the decision to use concrete sleepers is not only the most economic solution but will result in a railway track that can be maintained more economically and that the riding conditions will be much improved over previous standards.

Transport and Energy

A Background Paper released by the Australian Transport Advisory Council

A background paper on transport and energy has been released by the Australian Transport Advisory Council (ATAC).

ATAC, which comprises Commonwealth and State Transport Ministers, agreed at its last meeting in Darwin in July to develop a national transport energy programme.

The Council noted that the world oil-supply outlook was uncertain and that after the mid-1980s there could be an escalating risk of supply disruptions and price increases at a time when Australia was likely to be increasingly dependent on imports. In these circumstances it was necessary for plans to be formulated now to conserve oil and develop alternative liquid fuel supplies.

The Ministers agreed to support the following approach:

- As the largest consumer of petroleum fuel (about 60% of total petroleum energy), the transport sector has a major responsibility to restrain the rate of growth of its use of petroleum fuels.

- Future decisions by industry and government in the transport sector should, where appropriate, include specific consideration of their energy implications.

- In the evaluation of possible oil-conservation measures in transport, full consideration should be given to non-energy factors including the cost of other resources, social impacts (such as equity) and environmental factors.

- Positive and co-operative action is required on the part of government and the transport, manufacturing and operating industries to formulate and implement conservation measures, develop new transport technology and encourage their acceptance by the consumer.

- As coastal shipping and railways are relatively energy efficient in comparison with road transport for long distance freight, a major focus for transport energy conservation and research should be on road transport and the motor car in particular (the private motorist consumes about 60% of transport energy).

- Important areas of investigation include:

(a) measures which would encourage the manufacture, purchase and use of more fuel-efficient vehicles;

(b) measures to improve the operational efficiency of vehicles;

(c) other measures, including education and promotion campaigns;

(d) the role of public transport and, in particular, rail services.

- Immediate priority should be given to investigation, with a view to early implementation, of fuel economy labelling and other measures directed toward education and promotion campaigns.

- Governments should encourage the greater use of alternatives to petroleum fuel including fuel substitutes now available such as LPG, and alcohols as additives to petrol.

- Governments should encourage the research and development of new fuels and transport vehicles, and

- contingency plans should be developed to cater for possible interruptions to the supply of imported oil.

- Commonwealth and State Transport officials shall promote and monitor investigations that would assist in developing a national transport energy programme and shall liaise with the National Energy Advisory Committee, the National Energy Research Development and Demonstration Council, State Energy Committees and other responsible bodies in the energy field.

Copies of the transport and energy paper are available from the Commonwealth/State Transport Secretariat, Department of Transport, Canberra.

The Electrification of the Brisbane Suburban Railway System

1. Preliminary Investigations

This is the first in an eventual series of articles dealing with technical aspects of the project.

Investigations into the possibility of electrification of the Brisbane suburban rail system were started as far back as October 1915, when preliminary investigations were made into clearances and structure and rolling stock outlines, as well as annual track maintenance expenses.

On 8 July 1927, however, a memorandum from the Chief Engineer stated that electrification of the railways would necessarily presuppose certain conditions:

(1) A pronounced percentage annual increase in the metropolitan and suburban population which would guarantee an additional percentage of passengers travelling.

(2) That trains running with the minimum headway could not clear the platforms of passengers without greatly overcrowding the carriages.

(3) That the train sections had been reduced to a minimum, either by additional stopping places or by Automatic Signalling, to allow of the shortest headway between trains being maintained, especially during peak traffic hours.

(4) That the locomotives employed on the suburban services could be utilised for long-distance goods and passenger services, and that the long-distance traffic did not congest the electric suburban service.

The Chief Engineer stated that none of these conditions existed in Brisbane at that time.

The eventual electrification of the Brisbane suburban system had, however, been incorporated in a long-range planning programme which included other works such as the duplication of certain suburban sections and the quadruplication of track between Corinda and Northgate.

The Electrification Investigation Committee of Enquiry Report of 1947

In April 1947, the State Government set up an "Electrification Investigation Committee of Enquiry", comprising three members: Mr McDonald (Assistant Chief Mechanical Engineer, Victorian Railways), Mr Moffatt (Superintendent, Electric Rolling Stock, N.S.W. Railways), and Mr Egebert (Chief Engineer, Queensland Electricity Commission).

In a report dated 12 November 1947 this Committee recommended "the elecrification of the Brisbane suburban lines, using what is now considered the standard system for such installation, viz., 1500-volt direct-current overhead wires, and all-steel multiple-unit cars".

The report quoted a net expenditure of £2,504,660, after allowing for certain major credits — for car replacements, 62 steam locos released, and train lighting equipment.

The electrification proposals featured an improved signalling system, the acquisition of 95 new motor cars and 37 trailer cars, and the construction of 17 automatic sub-stations and 11 tie stations. The proposals also included the provision of 180 track miles of overhead wiring and structures, the construction of inspection pits and buildings at Mayne, reballasting of track, alterations to bridges, stations, etc., and provision of tools and plant.

The lines were to be electrified in the following order:

Ipswich — Shorncliffe
Northgate — Zillmere
Mayne — Ferny Grove
Eagle Junction — Pinkenba
South Brisbane — Lota
South Brisbane — Sunnybank
Corinda — Yeerongpilly
Sunnybank — Kingston
Zillmere — Petrie

Points stressed by the Committee included the need of a direct link between South Brisbane and the City, and the early formulation of a well-defined transport policy covering the next twenty years of development and including all modes of transport. It also noted that a large increase in business inevitably follows electrification, and that ample provision should be planned for such an increase in the form of new trains, etc.

The Committee stated that it was unnecessary to provide additional or special station facilities if substituting electrification for steam. It also noted that duplication of the section Yeerongpilly-Sunnybank was under consideration, that duplication of the Newmarket-Mitchelton and Eagle Junction-Ascot sections was also being urged, and that it was departmental policy to lay two additional tracks between Corinda and Northgate.

Comments from within the Department following release of the report included revised figures for certain items in the light of current prices. In his memo of 5 January 1948, the Chief Engineer stated that in his opinion the outlay required to bring about the electrification of the lines covered by the report would be in the vicinity of £5,000,000.

The "Moffatt and Webster" Report

In June 1948, a supplementary report on technical requirements was sought from Messrs Moffatt and Webster. Discussions with Departmental officers concerning signalling and the stabling of electric cars were the matters included.

On 20 February 1950, a report was submitted to the Minister for Transport. It included revised estimates of costs of electrification and associated works, as well as a rail connection between South Brisbane and Roma Street stations, the total estimate being £10,853,000.

On 23 February 1950, the Minister for Transport released a press statement announcing that State Cabinet had approved electrification of the Brisbane suburban rail system at an estimated cost of £8,853,000. The planned scheme was to provide 225 miles of electrified tracks, and was expected to take nine years.

The planned schedule was: Ipswich-Shorncliffe and Pinkenba Lines — 5 years; Petrie and Ferny Grove sections — 2 years; South Side — 2 years.

Items directly chargeable to electrification included:

Rollingstock
Power supply equipment
Signalling and communications
Mayne — conversion to electric car workshop
Mayne — signal shop facilities
Alteration to awnings, bridges etc
Realignment of tracks at stations
Lowering and waterproofing of tunnels
Provision of subway at Albion
Provision of overbridges at Campbell St and Fairfield Rd
Provision of level crossings.

Items not directly chargeable to electrification were

Signalling equipment for the third line
Refuge facilities at Goodna, Oxley, Northgate, Zillmere and Coorparoo
Thomas Street stabling sidings
Mayne — facilities for diesel-electric locomotive and air-conditioned trains
New locomotive and carriage depots at Northgate and Virginia
Remodelling Roma Street station
Replacing 60lb with 94lb rails

Messrs Moffatt and Webster were, between 1948 and 1954, intermittently in consultation with Departmental officers engaged in replanning and other aspects of electrification/quadruplication. Several other projects were considered during this period. These included:

Goods yards at Mayne, Virginia, Northgate, Normanby
Goods yard to relive Roma Street
Automatic signalling
Realignment of tracks
Transfer of Northgate Shops to Banyo
New bulk stores at Redbank
Workshops at Redbank
Electric car stabling facilities at Thomas St (Ipswich)

Review of the Position

In his memo of 8 March 1955, the Secretary requested a comprehensive statement setting out the scope of the electrification of the suburban railways, which would enable a technical man to get a grasp of the problems involved, the extent, the stage reached in planning, and the times when it was anticipated other stages would be completed or when the Department would be in a position to invite tenders for portions of the work.

In a review of the position as at 31 October 1955, the Chief Engineer listed the principal matters concerned with the overall planning of electrification:

(1) Clearances for overhead wiring and supporting structures.
(2) Location of sub-stations, tie stations and overhead sectioning.
(3) Arrangements at car depots, workshops and rail access to sites.
(4) Type of traction to be employed.
(5) Type of rollingstock and train equipment.
(6) Signalling and communications and traction return.
(7) Power supplies for traction and signalling.

The Washington — Carter Report

In May 1958, Messrs Washington (Metropolitan Vickers Elect. Co.) and Carter (British Thomson-Houston Co.), on behalf of Australian Electrical Industries Pty Ltd, submitted a report on Brisbane suburban electrification based upon a survey of the system. The general technical problems and their solutions to them were presented for a 1500 volt D.C., a 3000 volt D.C., and a 50 cycle A.C. system of electrification. Their conclusion was that the 3000 volt D.C. system showed a slight advantage over the 1500 D.C. system in respect of capital outlay and running costs, while it would also facilitate and cheapen any extensions of the electrified lines.

They added:

"A 50 cycle A.C. system would be initially more costly and more difficult to install. Some of its outstanding advantages are best achieved with heavy locomotive-hauled trains, and on a purely suburban system such as Brisbane these benefits cannot be realised. Furthermore, at the present stage of development, A.C. electrification is more likely to be subject to delays in execution, and perhaps early obsolesence in equipment."

Abandonment of the Programme in 1959

Based on the McDonald Report of 1947, a decision was taken to quadruple certain tracks as a prelude to electrification. During quadruplication, the opportunity was taken to increase structure clearances and arrange civil engineering works to the requirements of a 1500 volt D.C. overhead system. The programme was perforce abandoned in 1959, however, due to curtailment of loan funds; but extensive civil engineering works had been carried out. A considerable mileage of track was relaid with 94lb/yard rail to provide for the additional rail wear expected from the higher acceleration and retardation rates of electric stock, and also to provide a greater cross-sectional area for conductivity of return current.

Platforms at the majority of suburban stations, except on the south side, were lengthened from 400 ft to 520 ft, to allow for the operation of the projected nine-car electric trains. Considerable expenditure was also incurred in the raising of overbridges, both road and pedestrian, to provide the 16′0″ vertical clearance for the overhead wiring system. When the programme was abandoned in 1959, no actual detailed electrical design had been carried out, but the general principles had been laid down. Substation sites and capacities had been selected and acquired, and tie station sites allocated. Much design was done on an A.C. electric signalling system and the quadrupled track from Roma Street to Corinda was signalled specifically for electric traction requirements. In this area, the traction substations at Mayne and Corinda were part constructed, in order to supply power to the A.C. signalling system.

The Ford, Bacon & Davis Report of 1970

A report on "Long Range Improvements — Brisbane Suburban Passenger Service" produced by Messrs Ford, Bacon and Davis on 30 April 1970, recommended electrification of the suburban passenger service. It stated:

"Over the next 30 years the improved schedules made possible by electrification will be required to prevent deterioration of ridership on the Railways and attract future riders in the face of rising automobile registration and highway construction. The projections indicate that continued diesel-electric operation will not accomplish this task by itself. The first step in electrifying the operation of all off-peak service is more economical, even at present volume levels, than diesel-electric operation. As traffic volume justifies it and as equipment requires replacement, electrification can be extended to more peak hour trains and more lines."

The South-East Queensland Brisbane Region Public Transport Study

The South-East Queensland Brisbane Region Public Transport Study, prepared in 1970 by Messrs Wilbur Smith and Associates, recommended an electrified Brisbane suburban rail system for several reasons:

(1) Anticipated reduction in running times ranging from 15 to 30 per cent.

(2) Shorter turn-around times and faster running speeds with electric multiple-unit operation resulting in better utilisation of rollingstock and manpower, thus producing savings in both capital and operating costs.

(3) The greater flexibility of the electric multiple-unit train making it more practical to break up trains and reduce the number of cars in operation during off-peak periods when traffic is light.

(4) The quieter and smoother operation of the electric train would improve the quality of the ride to the passenger and reduce the noise level in neighbourhoods near the railway line.

The estimated capital cost for electrification and improvement of the railway system and completion of the rail link between South Brisbane and Roma Street stations was $22.2 million, expressed in 1969 dollar values.

The Bureau of Transport Economics Evaluations

In a study by the Bureau of Transport Economics entitled "Economic Evaluation of Capital Investment in Urban Public Transport", dated June 1972, the economic feasibility of electrification of the Northern Corridor was investigated as one of the evaluations. The Northern Corridor from central Brisbane consists of the Central to Shorncliffe line; the line from Northgate to Zillmere; the Pinkenba line from Eagle Junction to Hendra; and the Ferny Grove line from Mayne to Newmarket. The results of the evaluation produced benefit-cost ratios of the order of 2.5 and 1.8 at 7 per cent and 10 per cent discount rates respectively.

In the Bureau of Transport Economics report, "A Review of Public Transport Investment Proposals for Australian Capital Cities, 1973-74", dated August 1973, an economic evaluation of the Ferny Grove-Darra corridor produced benefit-cost ratios of 2.6 and 1.9 at 7 and 10 per cent discount rates respectively.

The report stated that the combined benefits to railway operations and to existing public transport users would cover all capital charges. Electrification would be justifiable even if there were no patronage increases.

Revival of Electrification

The moves in 1972/73 aimed at producing an improved Brisbane Urban Public Transport system, with the suburban rail system as the nucleus, brought about the revival of the electrification proposals. Electrification of the suburban railway system was included in the programme of urban transport improvement administered by the Metropolitan Transit Project Board, and the Railway Department undertook the specific implementation of rail projects on behalf of the Board.

Implementation and policy discussions were initiated in mid-1972. Items reviewed at that time included the system voltage, method of current collection, and design and construction procedures.

The A.C. System

From time to time, officers of Queensland Railways had made study trips to various countries and railway systems throughout the world, and there was evident a growing feeling that the state of technological advancement of A.C. industrial frequency systems had been reached wherein a review of the Brisbane system was warranted. Such a review was conducted in 1973, and resulted in a decision to change from the previous policy which stipulated a 1500 volt D.C. system to an A.C. 25 kV, 50 Hertz system which possessed all the potential for main-line extension should circumstances dictate such action in the future.

The Engagement of Consultants

On 3 October 1973, at a meeting of Departmental officers, agreement was reached in principle on the use of consulting firms generally. Such consultants would be responsible for the design for electrification and rationalisation of the communication system, signalling and safe-working system. They would not be responsible for the rollingstock or for civil works.

An outline brief was issued to four independent professional consulting engineering organisations who were considered to be among the most experienced in railway electrification. After analysis of proposals from these four organisations, the Minister for Transport announced on 5 August 1974, that Messrs Elrail Consultants Pty Ltd in association with Transmark, London, were appointed as consultants to carry out the design and supervision of construction of overhead equipment, the signalling system and ancilliary work in association with the electrification of the Brisbane suburban rail system. Elrail was also charged with the responsibility of training selected railway staff to operate and maintain the system and to recommend proposed safe-working systems.

Formation of the Commissioner's Electrification Policy Committee and the Technical Steering Committee

Two major committees were formed for the specific purpose of determining and implementing policy.

The Commissioner, a member of the Metropolitan Transit Project Board, determines Railway policy through his Electrification Policy Committee. The other members of this committee are the Chief Engineer, the Chief Mechanical Engineer and Workshops Superintendent, the General Manager, S.E.D., and Chief of Operations, and the Secretary. This committee's initial meeting was held on 10 October 1974.

The Technical Steering Committee comprises representatives of the members of the Electrification Policy Committee. Overall responsibility is to:

(a) Formulate and recommend standards for design, performance and operation for the electrification scheme;

(b) Keep Branch Heads fully briefed at all times on electrification work, and expedite Branch activity.

The Committee first met on 5 September 1974, and has since met regularly, making decisions and recommendations to the Policy Committee regarding design parameters and the introduction of electrification in general.

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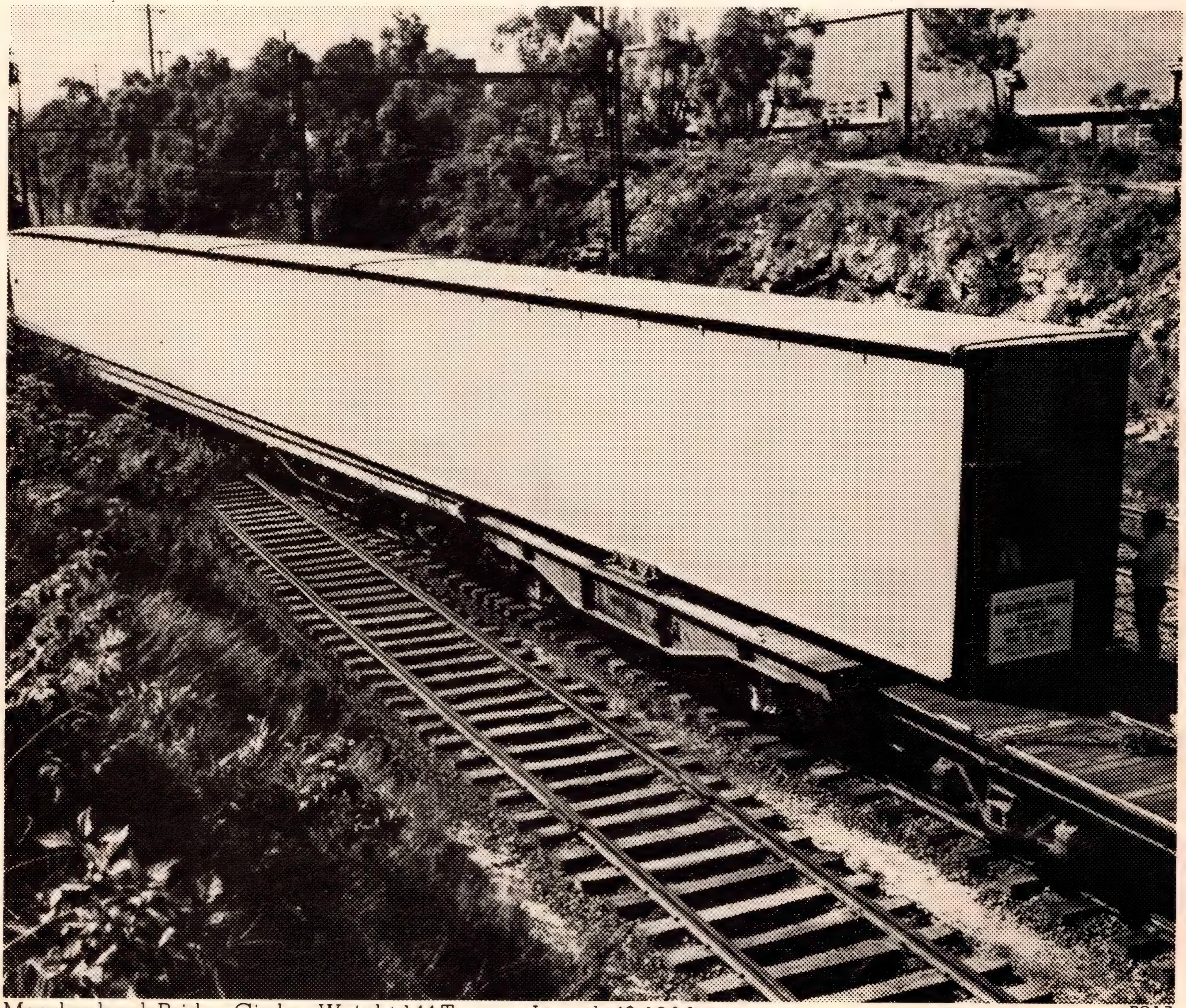

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ROA 7

A New Rail Link for the Ulan Coalfields

Future expansion of the vast Ulan coalfields is assured with the recent announcement by the Premier of New South Wales, Mr Neville Wran, that White Industries Ltd and Mitsubishi Development Pty Ltd had confirmed in writing their intention to construct a $40 million rail link between Ulan and Sandy Hollow and to upgrade the existing line between Sandy Hollow and Muswellbrook.

The decision means that coal from the Ulan fields will be transported directly by rail to Newcastle for the export market; whereas, at the present time, coal mined in the Ulan area is transported by road to Gulgong and then by rail to either Balmain or Port Kembla, a total distance of 447 kilometres.

Once the rail link is built the transport distances will be almost halved. The distance from Ulan to Newcastle and the Port Waratah coal-loader will be 275 km.

Mr Wran remarked that the construction of the Sandy Hollow railway had been a standing joke for more than four decades. It was originally scheduled for construction in 1927 and the project had been revived every few years, but no real construction work ever got underway. The railway would now be built, and would open up the vast Ulan coal deposits.

The Ulan deposits, located on the northern extremity of the Western Coalfield, about 250 km north-west of Newcastle, have been estimated by the NSW Department of Mines at some 14,000 million tonnes.

Mr Wran said the deposits would be brought into extensive production in the next few years, and it is expected that other major companies will be taking part in the development.

Among the companies which had expressed an interest are Thiess Brothers, Conzinc Riotinto of Australia and ENI (Ente Nazionale Idrocarburi), the Italian fuel and chemical group, which is interested in the prospects of using New South Wales coal for power supply in Europe.

Senior executives of the ENI subsidiary, AGIP, from Italy, have already begun detailed consultations with Ministers and Government officials in Sydney.

"The Government proposes, in co-operation with the companies concerned, to promote the systematic and efficiently staged development of the Ulan region, on lines giving maximum economic advantage to all the participants," said Mr Wran.

Recent Contracts include:

ANR — Supply of ballast: The Readymix Group (SA) ($2,290,000).

ANR — Supply of crossings and switchblades: Westinghouse Brake & Signal Co ($99,000).

QR — Construction of a deviation, Westwood to Gogango, Central Line: Thiess Bros Pty Ltd ($1,077,834).

QR — Manufacture, supply and delivery of fifteen refrigerated containers: ACI Reinforced Plastics Pty Ltd ($437,755).

QR — Construction of deviations 1D and 9D including raising of bridge at 934.470 km, Duchess to Mt Isa: Thiess Bros Pty Ltd ($223,853).

QR — Erection and completion of a new amenities building, Railway Workshop Yard, Ipswich: Girvan Bros (Qld) Pty Ltd ($276,386).

QR — Manufacture, supply and delivery of two lines (total 400) solid steel wheels: Bradford Kendall Foundries Pty Ltd ($119,408).

QR — Construction of roadworks, drainage, houses and miscellaneous buildings for the Norwich Park Railway project: Jennings Industries Ltd ($1,044,498).

QR — Repair of "WHO" wagons at Townsville: Vickers Ruwolt, Scotts of Ipswich Division ($713,582); Evans Deakin Industries Ltd ($424,750); GEA Trading Pty Ltd ($430,160).

QR — Supply of prepared stone ballast for five years, delivered into rail wagons in area bounded by Nerimbera, Tunnel, Parkhurst, and Edinda Railway Stations: Capricornia Quarries Pty Ltd ($1,569,000).

QR — Supply and delivery of glued insulated joints for centralised traffic control, Port Curtis to Tolmies: Portec (Aust.) Pty Ltd ($196,608).

QR — Erection and completion of a C.T.C. Control Centre building at Maryborough: Gympie Building Co Pty Ltd ($173,800).

QR — Manufacture, supply and delivery of one line of dogspikes: A. M. Bristow Pty Ltd ($156,750); Westinghouse Brake & Signal Co (Aust.) Pty Ltd ($150,490).

QR — Manufacture, supply and delivery of two lines of rolled steel tyres: Commonwealth Steel Co Ltd ($152,250).

QR — Supply of 20,000 cubic metres prepared stone railway ballast delivered into rail wagons or to stockpile at Barabon: Vunarok Crushing Co ($143,000).

VR — Manufacture, supply and delivery of open-sided freight containers: Hobson's Bay Enginering Pty Ltd ($469,900).

VR — Supply of plant mixed concrete to MURL construction sites: Pioneer Concrete (Vic.) Pty Ltd ($327,816).

VR — Supply of steel, 1/9/78 - 30/6/80: Lords Steel ($2,000,000 estimated).

VR — Design of circuits and manufacture and installation of automatic boom barriers at ten locations: Westinghouse Brake & Signal Co. (Aust.) Pty Ltd ($283,375).

VR — Collection, carriage and delivery of goods between Shepparton Freight Centre and town of Shepparton: Ronald H. Cubbin ($108,000).

WAGR — 500 wagon wheels: Bradford Kendall Foundries Pty Ltd ($192,000).

WAGR — 1 Tamping /Lining Machine: Plasser (Aust.) Pty Ltd ($122,000).

The Window Seat

The Secretary for Railways, Mr A. E. Williams, has been appointed Westrail's new Assistant Commissioner. He succeeds Mr McCullough who took over as Commissioner of Railways after October 31.

Mr Williams joined Westrail's Traffic Branch in 1936, transferring to the Accounts and Audit Branch in 1939. In 1951, he was appointed to the Finance Section of the Secretary for Railways Branch where he served until 1966 holding various positions including that of Commissioner's Special Officer. During this period he was a member of a mission headed by Mr Commissioner Wayne which studied various railway aspects, including transport coordination, overseas.

Mr Williams was appointed to the position of Assistant to the Director General of Transport when that office was established in 1966. In this position he assisted the Director General in the development of transport policy recommendations and procedures for evaluating investment in transport and cost/benefit and feasibility studies of the various alternative means of transporting both passengers and freight.

Mr Williams was appointed Comptroller of Accounts and Audit in 1971 and Secretary for Railways in 1972. He is a Fellow of the Australian Society of Accountants and a Member of the Chartered Institute of Transport.

* * *

The Queensland Government has commissioned a feasibility study for the electrification of the 640 km coastal route from Brisbane to Rockhampton, and the 160 km line from Brisbane to Toowoomba.

Margaret N. Alexander has been appointed Manager, Public Relations, for VicRail. Miss Alexander has worked with VicRail for nearly two years and for the past six months has been Deputy Manager in the Public Relations Division.

Previously, she was with the Melbourne Chamber of Commerce as Public Relations Officer, with the Australian Chemical Industry Council as Publications and Information Officer, and was for nine years a Publicity Officer with the Department of Overseas Trade. Miss Alexander also ran her own Public Relations Consultancy in Melbourne.

Before coming to Australia nineteen years ago, Miss Alexander was employed with the British Foreign Office, and travelled widely as Press Officer for various Government officials and missions.

The contract was awarded to P. G. Pak-Poy and Associates of Adelaide, in association with Transmark and Elrail, both of whom are engaged in the current Brisbane electrification project. The investigation should be finished within a year, and will cost $500,000.

Queensland favours electrification programmes because its abundant reserves of coal will facilitate low-cost generation of electricity.

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According to *International Railway Journal's* latest survey of world railway budgeting for 1978, the French Railways (SNCF) will be laying out this year about £55 million on traction, £150 million on passenger rolling stock (excluding Paris suburban equipment), £158 million on TGV Sudest construction and the huge schemes of cross-Paris lines, £44 million on electrification, and nearly £75 million on signalling and telecommunications. The total investment for the year is approximately £720 million.

These figures reflect the scale of public support for French rail development. Since 1962 the former Paris Region Authority and the new Regional Council (established in 1976) have earmarked more than a quarter of their total investment budget for improvement in the city's rail transport.

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Railway Gazette International reports s significant development in British rail steel technology, which will bring the benefits of continuous-welded rail to passengers on sharply-curved commuter and metro lines, as well as considerably lengthening rail life under the same conditions.

A joint development programme between British Rail, the British Steel Corporation, and two specialist welding companies has produced a weldable version of the most wear-resistant of rail steels — Hadfield's austenitic manganese steel.

BR pioneered continuous welding of rail, and has over 14,000 track-km in service. So far, however, the advantages have been confined mostly to main lines. The application of continuous welding to sharply-curved commuter tracks was not possible for two main reasons— heat applied during welding made the steel more brittle, and the wear-resistant steel's much higher co-efficient of expansion, compared with other steels, created excessive stresses on curves during expansion and contraction with temperatures.

A five-month trial of the weldable austenitic rail has been completed on busy suburban lines in north-east London. Where rails of normal wear-resistant steel were being renewed after very short service, despite the use of rail lubricators, the weldable wear-resistant rail has shown no detectable change in profile.

Passengers now enjoy smoother and quieter travelling. BR has reduced rail wear and rolling-stock maintenance costs. The development is expected to have wide application on suburban and rapid transit systems, elsewhere in Britain and also overseas.

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